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(54) **A separator of solid particles for variable discharge fluid flow rates in dental apparatus**

Abscheider fester Partikel für den variablen Abzug von Flüssigkeitsströmen in einem zahnärztlichen Apparat

Séparateur des particules solides pour débit fluide à décharge variable dans un appareil dentaire

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Description

The invention relates to a separator of solid particles for variable discharge fluid flow rates in dental apparatus.

In dental apparatus there is a production of fluids containing water, blood, amalgam, chemical products, etc., which must be discharged to the sewers respecting the anti-pollution laws which state that certain substances, such as amalgam and the like, may not be so discharged.

In particular, in dental apparatus that uses liquid ring pumps to aspirate fluid from the mouth of the patient, the production of polluting fluids that contain air, various liquids and heavy particles, is quite abundant if discontinuous. Before being discharged into the sewers, these fluids must be freed of the above-mentioned polluting fluids.

In order to effect the separation of the solid particles from the said fluids, various systems are presently in use such as for example decanting systems which employ syphons, filtering systems and centrifuge systems.

Each of these systems presents some drawbacks. Filtering systems, for example, require very frequent maintenance due to the need for filter substitution; sedimentation systems are not able to deal with large quantities of fluid and do not offer, in particular for elevated quantities of fluids, a sufficient degree of separation within acceptable times. Centrifuge systems require rather expensive and delicate apparatus, whose cost and constructional complications increase considerably when the fluid flow rates to be dealt with are high.

An aim of the present invention is to optimise the solid-particle separation devices, in particular for apparatus with discontinuous fluid production, by providing a separator that needs little maintenance, which is able to discharge variable quantities of fluid in a relatively short time and which provides a very high degree of separation, even in the case of small-dimension particles, over a large range of different discharge fluid flow rates.

These aims and advantages and more besides will all be attained by the invention, as it is characterised in the claims that follow, which comprises a container equipped with a cylindrical zone, equipped with an inlet hole for the fluid to be separated, in which cylindrical zone the rotor of a centrifuge pump rotates, which rotor initialises the separation of the particles by centrifugation; the invention further comprises a truncoconical zone which, opening a discharge hole in the container, functions as a cyclone in such a way as to continue the separation of the solid particles and cause the expulsion of the fluid, by now freed of the particles, from the container.

Further characteristics and advantages of the present invention will better emerge from the detailed description that follows, together with the accompanying drawings which represent a preferred but not exclusive embodiment and in which:

- Figure 1 shows a schematic view in vertical elevation of the various parts of the separator;
- Figure 2 shows a section, in vertical elevation and in enlarged scale, of the container of the separator.

The separator object of the invention comprises a separator chamber 1 which receives the fluids produced by a dental apparatus (not illustrated); these fluids comprise a gaseous part, generally air, a liquid part, generally water and other liquids used by the dental apparatus, as well as a solid part represented by solid particles, in particular by amalgam used for dental operations.

In the separator chamber 1 the gaseous part of the fluid is separated from the remaining part of the fluid and exits upwards; the remaining part of the fluid collects in the chamber 1. In figure 1 the separator chamber 1 is shown as a separate element; the said separator chamber 1 could however form a single body with the remaining parts of the separator since its function is principally that of creating a water head and controlling its level.

Internally to the chamber 1 a probe system 14 is provided, of known type, which reads the level of the liquids inside the separator chamber 1 and provides command signals in relation to the levels recorded, of which more will be said hereinafter.

The separator further comprises a container 3 equipped with an inlet hole 5 connected to the separator chamber 1; through the inlet hole 5 the container 3 freely receives the fluid from the separator chamber 1. In cases where the separator chamber 1 is at a lower level than the container 3, the passage of the fluid from the separator chamber 1 to the container 3 will be forced.

A collector 4 is provided on the bottom of the container 3, in which collector 4 the solid particles deposit; in the upper part of the container 3 an upper outlet hole 7 is provided, from which the liquids exit to the sewers once they have been cleaned of the solid particles.

The container 3 comprises an upper cylindrical zone 3a wherein the inlet hole 5 is bored.

In the upper cylindrical zone 3a is the rotor 2 of a centrifugal pump whose inlet is connected to the inlet hole 5 in such a way that the fluid entering the container 3 all passes through the centrifugal pump itself. The rotor 2 is solid in rotation with a shaft 12 set in rotation by means of an electric motor 15. The upper cylindrical zone 3a does not communicate with the upper outlet hole 7 if not by means of the rotor 2.

The container 3 further comprises a lower truncoconical zone 3b the larger base of which is directly and freely connected to the upper cylindrical zone 3a and the smaller base of which opens into the collector 4.

A stop 13 is solidly connected to the smaller base of the lower truncoconical zone 3b, which stop 13 is contained in the collector 4; slits 11 are cut into the stop 13 and develop in an axial direction, placing the truncoconical zone in communication with the collector 4.

A spiral 8 is envisaged on the internal wall of the

upper cylindrical zone 3a, which spiral 8 is arranged to be underlying the rotor 2 of the pump and terminates in proximity to the connection zone between the cylindrical and truncoconical zones of the container 3.

Also envisaged is a conduit 6, one end of which is arranged axially to the truncoconical zone and in proximity to the larger base of the said zone, and whose other end is connected with the upper outlet hole 7. The conduit 6 is bored internally to the hollow shaft 12.

One or more spiral channels 16 are made in the cavity of the shaft 12 for the passage of the fluid.

A tap 9 is arranged on the upper outlet hole 7 which tap's 9 opening and closing are commanded by the signals generated by the probe system 14.

The functioning of the separator happens in the following way.

The fluid, constituted by air, liquid and solid particles, coming from the dental apparatus, enters the separator chamber 1; the air, and in general all of the gaseous parts, are separated and exit from the top of the separator chamber 1 while the liquid part which the solid particles suspended in it descends towards the lower part of the separator chamber 1 and passes freely into the container 3, in which container 3 the rotor 2 is continually in rotation and the tap 9 is normally closed.

The fluid entering into the container 3 passes through the rotor 2 of the pump and is centrifuged by it; in this way the solid particles are thrown towards the walls of the container 3 and, descending along the said walls, are conveyed into the collector 4.

The tap 9 being closed, the container 3 fills completely with fluid. Thanks to the action of the rotor 2, the fluid in the container assumes a rotary motion about the rotor axis; in this way the separation of the solid particles continues, and they are centrifuged and pushed towards the wlls of the container 3, where they slide towards the collector 4.

When the probe system 14 shows that a certain predetermined level of fluid has reached the separator chamber 1 (that is, the separator), a command signal is generated which causes the tap 9 to be opened, thus permitting the discharge of the liquid from the conduit 6.

The fluid exiting from the rotor 2 crosses the spiral 8 which generates a downward push and favours the creation of a primary vortex within the lower truncoconical zone 3b; at the smaller base of the lower truncoconical zone 3b a secondary vortex is established which rises upwards and permits the discharge of the water through the upper outlet hole 7. The vortex motion of the exiting fluid is favoured by the presence of the spiral channels 16.

In substance, by opening the tap 9, the lower truncoconical zone 3b behaves like a cyclone separator; also in the cyclone the solid particles are centrifuged against the walls of the container and descend towards the collector 4.

It should be noted that any eventual solid particles being transported upwards by the secondary vortex are centrifuged and returned downwards by the primary vortex.

When the level of the fluid in the separator chamber 1 falls below a second predetermined level, a further command signal is generated which causes the tap 9 to close; the motion of the fluid, towards the outlet, is interrupted, as is the secondary vortex of the cyclone; the fluid in the container 3 only maintains its rotary movement about the rotor 2 axis.

Apart from a brief initial transistory stage, the separator functions with the container 3 always full of fluid. The rotor 2 thus always rotates immersed in fluid and has the sole function of causing the rotary motion of the fluid contained in the container; this function is not influenced by the flow rate of the fluid and the rotor 2 can thus be very small in construction and have large inlets and outlets which do not tend to block.

When, following the opening of the tap 9, the cyclonic vortices are created, the normal drawbacks occuring in cyclonic separators and due to variations in flow rate do not arise, since given that the container 3 is always full, there are in fact no flow rate variations. It should also be noted that the rotary motion of the fluid is always initially caused by the rotor 2.

The separator behaves as a centrifugal separator, without discharge, when the tap 9 is closed, while it behaves as a cyclone separator, with constant flow rate, when the tap 9 is open. Also worthy of note is the fact that the cyclone treats fluid which is already at least partially freed of solid particles, which have been separated by centrifugal effect, to an extent depending on the time during which the separator has functioned solely as a centrifugal separator.

The slits 11 of the stop 13 almost completely deaden the turbulence of the fluid which enters the collector 4, and the same slits 11 prevent solid particles from being drawn upwards by the said turbulence and returned to the container 3.

Once the collector 4 contains a predetermined quantity of solid particles, the functioning of the separator is stopped and the separator is emptied of the fluid still contained in it; in these conditions the collector 4 can be disconnected and emptied.

Claims

1. A separator of solid particles for variable flow rates of discharge fluids from dental apparatus, of the type comprising a container (3) which, through an inlet hole (5) receives the fluid from a separator chamber (1) in which the fluids are freed of a gaseous part, on a bottom of which separator chamber (1) a collector (4) is provided in which collector (4) solid particles of the fluid are deposited and above which collector (4) an upper outlet hole (7) is located from which the liquids exit, freed of solid particles, which solid particles are discharged into a sewer, characterised in that the said container (3) comprises: an upper cylindrical zone (3a) wherein an inlet hole (5) is bored; a centrifugal pump, having

a rotor (2) is contained in the said upper cylindrical zone (3a); a lower truncoconical zone (3b) having a larger base directly and freely connected to the upper cylindrical zone (3a) and which smaller base terminates in the said collector (4); a conduit (6), one end of which is arranged axially to the truncoconical zone (3b) and in proximity to the larger base of the said truncoconical (3b) zone and the other end of which is connected to the upper outlet hole (7); a tap (9), which is arranged on the upper outlet hole (7), which tap (9) opening and closing are commanded by means of known type devices, by predetermined levels of liquid which gather in the separator; the said upper cylindrical zone (3a) not being in communication with the upper outlet hole (7) if not by means of the rotor (2) of the pump.

2. A separator as in claim 1, characterised in that it comprises a spiral (8) arranged on an internal wall of the upper cylindrical zone (3a) in a position underlying the rotor (2) of the pump.

3. A separator as in claim 1, characterised in that it comprises a stop (13) contained in the collector (4) and solidly connected to a lower base of the lower truncoconical zone (3b), on which a plurality of slits (11) are cut, which slits (11) develop in an axial direction and place the truncoconical zone in connection with the collector (4).

4. A separator as in claim 1, characterised in that the said conduit (6) internally comprises at least one spiral channel (16) for the passage of the fluid.

Patentansprüche

1. Abscheider fester Partikel für den variablen Abzug von Fluidströmen in einem zahnärztlichen Apparat, der Art, daß er einen Behälter (3) enthält, der über eine Eintrittsbohrung (5) das Fluid aus einer Abscheidekammer (1) erhält, in welcher die Fluide von einem gasförmigen Anteil befreit werden, wobei auf dem Grund derselben ein Fänger (4) vorgesehen ist, in welchem sich die festen Partikel des Fluids absetzen und oberhalb desselben Fängers (4) eine obere Austrittsbohrung (7) vorgesehen ist, aus welcher die Flüssigkeiten, von festen Partikeln befreit, austreten, wobei die festen Partikel in einen Abwasserkanal abgelassen werden, dadurch gekennzeichnet, daß der besagte Behälter (3) enthält: einen oberen zylindrischen Bereich (3a), in welchem eine Eintrittsbohrung (5) eingearbeitet ist; eine Zentrifugierpumpe, deren Laufrad (2) in dem besagten oberen zylindrischen Bereich (3a) angeordnet ist; einen unteren kegelstumpfförmigen Bereich (3b), dessen größere Grundfläche direkt und frei mit dem oberen zylindrischen Bereich (3a) verbunden ist und dessen kleinere Grundfläche in den besagten Fänger (4) mündet; eine Leitung (6), von der ein Ende axial zum kegelstumpfförmigen Bereich (3b) und in der Nähe dergrößeren Grundfläche des besagten kegelstumpfförmigen Bereichs (3b) angeordnet ist, und von der das andere Ende mit der oberen Austrittsbohrung (7) verbunden ist; einen Hahn (9), der an der oberen Austrittsbohrung (7) angeordnet ist, wobei dessen Öffnung und Schließung gesteuert wird durch bekannte Vorrichtungen bei vorher festgelegten Fluidpegeln, die sich im Abscheider einstellen; wobei der besagte obere zylindrische Bereich (3a) nicht mit der oberen Austrittsbohrung (7) in Wirkbeziehung steht, wenn nicht über das Laufrad (2) der Pumpe.

2. Abscheider nach Anspruch 1, dadurch gekennzeichnet, daß er eine Spirale (8) enthält, die auf der Innenwand des oberen zylindrischen Bereichs (3a) in zum Laufrad (2) der Pumpe untergeordneten Stellung angeordnet ist.

3. Abscheider nach Anspruch 1, dadurch gekennzeichnet, daß er einen Stopfen (13) enthält, der im Fänger (4) angeordnet und fest mit der unteren Grundfläche des unteren kegelstumpfförmigen Bereichs (3b) verbunden ist, auf welchen eine Mehrzahl von Schlitzen (11) herausgearbeitet ist, die sich inaxialer Richtung erstrecken und den kegelstumpfförmigen Bereich mit dem Fänger (4) in Verbindung bringen.

4. Abscheider nach Anspruch 1, dadurch gekennzeichnet, daß die besagte Leitung (6) in ihrem Inneren wenigstens einen spiralförmigen Kanal (16) für den Durchfluß des Fluids enthält.

Revendications

1. Un séparateur des particules solides pour débit fluide à décharge variable dans un appareil dentaire, du type qui comprend un récipient (3) lequel, à travers un orifice d'entrée (5) reçoit le fluide provenant d'une chambre séparatrice (1) dans laquelle les fluides sont libérés de leur partie gazeuse, sur le fond de ladite chambre séparatrice (1) se trouve un collecteur (4) dans lequel collecteur (4) les particules solides du fluide sont déposées et au-dessus duquel collecteur (4) est logé un orifice de sortie supérieur (7) duquel sortent les liquides, libérés des particules solides, lesquelles particules solides sont déchargées dans les égouts, caractérisé par le fait que ledit récipient (3) comprend: une zone cylindrique supérieure (3a) dans laquelle se trouve un orifice d'entrée (5); ladite zone cylindrique supérieure (3a) contient une pompe centrifuge, laquelle a un rotor (2); une zone tronconique inférieure (3b) dont la base la plus grande est reliée directement et librement à la zone cylindrique supérieure (3a) et dont la base la plus petite termine dans ledit collecteur (4); un conduit (6) dont une extrémité est dis-

posée axialement par rapport à la zone tronconique (3b) et à proximité de la base la plus grande de ladite zone tronconique (3b) et dont l'autre extrémité est reliée à l'orifice de sortie supérieur (7); un robinet (9) qui est disposé sur l'orifice de sortie supérieur (7), l'ouverture et la fermeture dudit robinet (9) sont commandées au moyen de dispositifs de type connu, par les niveaux prédéterminés du liquide qui est recueilli dans le séparateur; ladite zone cylindrique supérieure (3a) n'étant en communication avec l'orifice de sortie supérieur (7) qu'au moyen du rotor (2) de la pompe.

2. Un séparateur comme celui de la revendication 1, caractérisé par le fait qu'il comprend une spirale (8) disposée sur la paroi intérieure de la zone cylindrique supérieure (3a) dans une position qui se trouve au-dessous du rotor (2) de la pompe.

3. Un séparateur comme celui de la revendication 1, caractérisé par le fait qu'il comprend un bouchon (13) qui est contenu dans le collecteur (4) et qui est relié solidairement à la base inférieure de la zone tronconique inférieure (3b), sur lequel sont réalisées une pluralité de fentes (11), lesquelles fentes (11) se développent dans la direction axiale et mettent la zone tronconique en communication avec le collecteur (4).

4. Un séparateur comme celui de la revendication 1, caractérisé par le fait que ledit conduit (6) comprend, à l'intérieur, au moins un canal à spirale (16) destiné au passage du fluide.

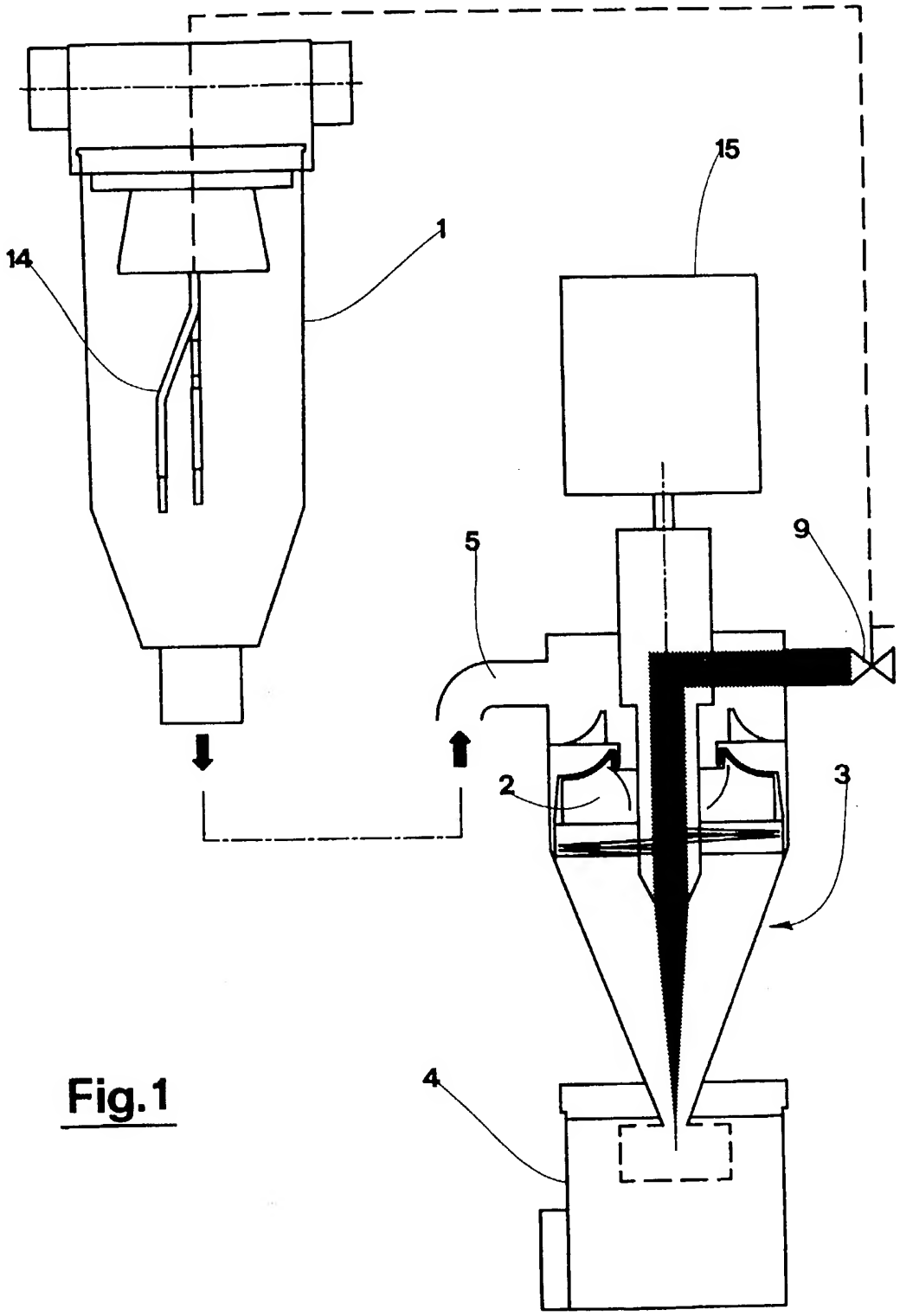

Fig.1

Fig. 2